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ABSTRACT

A home-based reinforcement program was instituted with three underachieving fourth graders who exhibited inappropriate behavior. Each day the children brought home a workbook assignment indicating percentage of correct responses and parents provided reinforcement for correct items and for improvement over time. Effectiveness on completion of daily assignments and performance of inappropriate behavior was examined via visual inspection and interrupted time-series analysis. Parents received initial training in implementing the reinforcement program along with a book outlining similar procedures. In addition, weekly followup contacts were made. All students improved on both behavioral and academic performance. Academic performance covaried with the levels of corresponding inappropriate behavior of target students. The simplicity of the intervention was stressed. (CL)

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Home-Based Reinforcement: Behavioral Covariation Between Academic Performance and Inappropriate Behavior

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Abstract

This article describes the effects of a home-based reinforcement program on the academic performance and inappropriate behaviors of three fourth-grade boys. Home contingencies were placed on only academic performance. The home-based system resulted in marked increases in academic performance and large decreases in disruptive behavior for all three subjects. Throughout baseline and treatment conditions there was a strong negative correlation between academic performance and disruptive behavior. The intervention was evaluated using both visual inspection (multiple baseline across subjects) and interupted time-series analysis.

Home-Based Reinforcement: Behavioral Covariation Between Academic Performance and Inappropriate Behavior

In order for a classroom intervention to be utilized by harried teachers it must be efficient in terms of time and person resources, and it must be effective in modifying classroom behavior (Bergan & Neumann, 1980; Witt & Elliott, in press). In this vein, Patterson, Cobb, and Ray (1971) suggested: "Because most of the teachers with whom we worked had a deep antipathy towards the whole idea of behavior modification, the emphasis has been to develop an approach which requires low response cost on the part of the teacher" (p. 151). A behavioral intervention which lacks effectiveness, requires excess teacher time, and is too expensive is likely to be discarded by teachers. The design of strategies which are easy to implement, while remaining effective, is an important mandate for behavior change agents.

Home-based reinforcement progams, designed to modify classroom behaviors, are well-established interventions which have proven useful for controlling a wide variety of students across a wide array of situations (Atkeson & Forehand, 1979; Barth, 1979; Berkowitz & Graziano, 1972; O'Dell, 1974). Typically a teacher reports by means of a note to parents the degree to which a child has performed appropriately at school. Parents subsequently institute contingencies in the home depending upon the student performance described in the note. The sending home of a note usually requires considerably less effort than is needed for even simple token economies or other interventions based solely in the classroom. Additionally, the type and quality of reinforcers available in the classroom pale in comparison to those available to parents (Ayllon, Garber, & Pisor, 1975; Atkenson & Forehand, 1979; Bailey, Wolf, & Phillips, 1970; Schumaker, Hovell, & Sherman, 1977).

Home-based systems have been used successfully to decrease disruptive classroom behaviors (Ayllon, Garber, & Pisor, 1974; Budd, Leibowitz, Riner, Mindell, & Goldfarb, 1981; Clark, 1972; Todd, Scott, Bostow, & Alexander, 1976), increase appropriate academic behaviors (Karraker, 1972; Saudargas, Madsen, & Scott, 1977), and to effect positive change in some combination of academic and disruptive behaviors (Bailey, Wolf, & Phillips, 1970; Heaton, Safer, Allen, Spinnato, & Prumo, 1976; Lahey, Gendrich, Gendrich, Schnelle, Gant, & McNees, 1977; Martin, Brukholder, Rosenthal, Tharp, & Thorne, 1968; Schumaker, Hovell, & Sherman, 1977; Strober & Bellack, 1975). Home-based programs which focus on academic behaviors offer several distinct advantages over programs where contingencies have been applied solely to disruptive behaviors. First, they tend to be easier for teachers to implement since it is easier to record academic behavior, such as percent correct on homework, than to monitor accurately a disruptive behavior, such as talking, which may occur throughout the day. Second, parents may be able to help teach and intervene directly with academic behaviors. Third, programs which focus exclusively on disruptive behavior have been criticized because reducing disruptive behavior does not necessarily result in a corresponding increase in academic achievement (Ferritor, Buckholdt, Hamblin, & Smith, 1972). Moreover, a focus solely on disruptive behavior may encourage and facilitate the notion that teacher effectiveness should be evaluated more on the basis of maintaining an orderly, quiet classroom than on the basis of increases in student performance (Ayllon & Roberts, 1974). In this context, Winnett and Winkler (1972) chided the behavior modification establishment for helping to maintain order and control when "it may be that learning can take place more effectively if it can be accompanied by singing and laughing and whistling

and that a quiet, controlled, docile classroom may not be only unnecessary but destructive" (p. 500).

Although a home-based reinforcement program which focuses on academic performance appears to offer some advantages, the effectiveness of such a procedure remains unknown. Studies which have included academic behaviors typically have not focused on specific performance (i.e., number of problems completed correctly); instead, listening to the teacher or looking at one's paper has typically been defined as academic behavior (Atkeson & Forehand, 1979). The broader definition typically applied to academic behavior does not offer the same advantages as a definition limited to academic performance. Investigations which have included academic performance as a home-based contingency have also included contingencies on disruptive behavior (e.g., talking, out-of-seat). This method renders impossible the evaluation of the unique contributions of reinforcing academic performance (cf. Schumaker, Howell, & Sherman, 1977).

The purpose of the present study was to examine the effects of a home-based academic reinforcement program on academic performance and to observe collateral effects on inappropriate behavior. A promising approach to the evaluation of such a program has been referred to as response covariation (Russo, Cataldo, & Cushing, 1981; Wahler, 1975) in which two behaviors are correlated over time and only one is treated and modified. The untreated behavior will change in a direction indicated by the valence of the correlation coefficient. The response covariation hypothesis has important practical and theoretical implications because "If a child's behavior repertoire is indeed organized into functional clusters, it is conceivable that his or her deviant actions might be modified indirectly." (Wahler, 1975, p. 28). Thus,

behaviors which are difficult or time consuming to alter directly may be changed by altering related behaviors which can be modified more easily or cost effectively. Although the mechanisms of behavioral covariation have not been fully studied, it is possible that the increased student effort directed toward the reinforced behavior results in a generalized effect on related behaviors. From previous reports of classroom-based interventions which have focused on academic performance, behavioral covariation between academic performance and disruptive behavior was expected (Aaron & Bostow, 1978; Ayllon, Layman, & Burke, 1975; Ayllon & Roberts, 1974; Broughton & Lahey, 1978; Hay, Hay, & Nelson, 1977; Marholin & Steinman, 1977; Moracco & Fasheh, 1978).

Method

Subjects

Three fourth-grade male students were chosen from a class of 26 students on the basis of the following criteria: (a) each was performing poorly on in-class assignments; (b) each was considered by the teacher to engage in high rates of inappropriate behavior; (c) for each a multidisciplinary team had determined that ability and achievement were commensurate with current grade placement. All three children performed in the average range on the Wechsler Intelligence Scale for Children-Revised (Ron = 112, Wade = 104, Wes = 92) and all had achievement test scores in reading, math and spelling which were above the 40th percentile. The multidisciplinary team determined that the students were capable of completing the work assigned but that their behavior was interfering with academic progress. Two of the children were evaluated by the team during the same year the present intervention occurred and one was evaluated the previous school year. All children were Caucasian and were from middle-class home environments.

Response Definitions

Academic performance. The experiment was instituted during a 30-minute reading/language arts period when the children were engaged in seat work or listening to short presentations by the teacher. This work period was selected by the teacher as the most problematic in terms of both assignment incompletion and inappropriate behavior. During this time the children were required to produce written responses to workbook questions and to turn in their responses at the end of the session. The teacher used her professional judgment to select assignments which could be completed easily within 30 minutes. Daily assignments consisted of 10-25 (completion, matching, and true-false) items which covered academic content. Academic performance was defined as the percentage correct on these daily assignments.

Inappropriate behavior. Inappropriate behaviors were defined according to the observational system developed by Madsen, Becker, & Thomas (1968) and included: gross motor (e.g., getting out of seat, running, moving chair), object noise (e.g., tapping pencil), disturbance of others' property (e.g., grabbing objects or work), contact (e.g., hitting), verbalization, turning around, mouthing objects, and other inappropriate behavior (e.g., ignores teacher's question or command). The same 30-minute instructional period used for monitoring academic performance was used as the behavior recording period. Observers attended class several days prior to the beginning of the experiment to allow the children to adapt to their presence. Observations of inappropriate behavior were made using 20 seconds for observation and 5 seconds for recording. The children were assigned a "+" or a "-" during each observation interval: children were scored as "-" if any category of inappropriate behavior occurred. They were given a "+" if no inappropriate behaviors

occurred. The number of observations per session ranged from 53 to 72 intervals. Inter-rater reliability checks were carried out in 33% of the observational sessions distributed across experimental conditions. Observers listened to a recorded audio tape to insure they were simultaneously recording the same interval. Reliability was calculated by dividing the number of exact agreements between observers by agreements plus disagreements and multiplying by 100 to yield a percentage. Reliability ranged from 80% to 97% with a median of 92%.

Procedure

Baseline. No formal contingencies were applied during this condition, and the teacher was instructed to manage the class in the usual manner. Inappropriate behaviors were recorded by the observers while the teacher maintained a record of the percentage correct on targeted daily in-class assignments. Since the home-based reinforcement system was introduced sequentially in multiple baseline fashion, the length of the baseline differed for each child.

Home-based reinforcement. Immediately prior to the end of the baseline condition, an individual conference with each child's parents was conducted to discuss the home-based reinforcement program. The purpose of the conference was to provide the parents with specific information about their involvement. They were told that each day their child should bring home a workbook assignment with the percentage of correct responses indicated. The assignment would be obtained during a period of the day when failure to complete assignments and inappropriate behaviors were particularly problematic for their child. The parents were asked to provide praise, privileges, and encouragement for both the items completed correctly on the daily assignment and for improvement over time. The parents were given information regarding

how to praise their children and how to select privileges which would be of interest to their children. Information followed closely the format summarized in Patterson's (1975) Families, and the book was loaned to each family. The degree to which parents studied the book was not monitored. Following implementation of the program, parents were contacted at weekly intervals to ensure that privileges were being distributed systematically, to monitor the amount of progress each family was expecting from the target child, and to assist with any implementation problems which arose. The initial meeting with the parents required approximately one hour and the weekly telephone contacts usually lasted less than five minutes.

As part of the initial behavioral shaping process, parents were asked to provide praise and privileges during the first week contingent upon their child remembering to bring home the assignment. The parents were asked to review the assignment with their child, and to praise the child for items answered correctly. If no items were answered correctly, parents praised only for bringing home the assignment. When their child failed to bring home the assignment, the parents were instructed to respond in the same manner as when assignments had no correct items (i.e., child fails to earn privileges). During week two and thereafter, parents were asked to continue praising their child for correct responses but privileges were to be made contingent upon improvement or on performance which exceeded a specific criterion. The amount of improvement and the level of the criterion were negotiated between the child and his parents.

Interaction with the teacher included an initial 30-minute session designed to elicit cooperation and to explain the purpose of the program. Following this session, the only teacher involvement was to have the papers graded for each target student and return the paper to the child before the

end of the school day. The grading was performed by an aide and was an ongoing practice prior to the study. To insure internal validity of the multiple baseline design, every effort was made so that target children were unaware of the contingencies being placed on other target children. No changes in classroom routine occurred when a child entered the intervention phase. Further, the teacher was instructed to refrain from discussing any aspects of the program in front of the class. Although it was impossible to control interactions between target subjects, there was no indication that the children were aware of contingencies placed on other target children.

Results

The effects of home-based intervention on daily assignment completion and inappropriate behavior were examined via visual inspection and interrupted time-series analysis (Glass, Wilson, & Gottman, 1975; Jones, Weinrott, & Vaught, 1978). The data for each student are presented in Figure 1. As shown in Figure 1, performance patterns changed from higher levels of inappropriate behavior and lower levels of academic performance during the baseline period to lower levels of inappropriate behavior and higher levels of academic performance during the home-based treatment intervention.

Insert Figure 1 about here

The correlation between inappropriate behavior and accuracy of academic performance for each subject are summarized in Table 1. As shown, the overall correlation coefficients remained negative in both baseline and treatment phases. This pattern was relatively stable across subjects.

Insert Table 1 about here

Due to the marked variablity observed in the baseline data for both academic and behavioral indicators, the data were analyzed using an extended application interrupted time-series data analysis procedure (see Bower, Padia, & Glass, 1974). Although the number of baseline observations was considered fewer than desirable (see Gottman & Glass, 1978), especially for subjects 1 and 2, the application of time-series analysis as a supplementary decision aid was considered useful (Hartmann, Gottman, Jones, Gardner, Kazdin, & Vaught, 1980). Two analyses were conducted: overall treatment effect using pooled data, and individual treatment effects. The pooled data were derived by utilizing the maximum number of common baseline observations about the point of intervention for all students, resulting in fewer degrees of freedom for the pooled analysis. These analyses roughly parallel the main effect and individual contrast statistical procedures used in classical hypothesis testing. As shown in Table 2, the results of the analysis of the overall intervention effect indicated significant differences from baseline-to-treatment for both percent of correct academic responses, $t(13) = 3.66$, $p < .005$, and percent of inappropriate behavior, $t(13) = -3.63$, $p < .005$. These findings confirmed the conclusions made based upon visual inspection. The pattern of mean score differences obtained for the overall academic and behavior treatment effect was identical to the corresponding patterns obtained by each of

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Insert Table 2 about here

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the three target subjects. Changes in the linear patterns of academic performance and inappropriate behavior from baseline-to-treatment, however, were not consistent across subjects. As shown in Figure 1 and by the change in slope statistics in Table 2, subjects varied with regard to the extent to which the direction of the academic and behavioral performance patterns were affected by the home-based intervention. As Table 2 indicates, Student 1, Ron, improved on both behavioral and academic criteria, and there was a significant change in slope for academic performance but not behavior. Wade, student 2, improved in levels of performance on both criteria, but the slope of the performance on both criteria was consistent from baseline to treatment. The third student, Wes, also improved on both criteria; however, the slope for behaviors during the treatment period indicated a gradual low incidence escalation of inappropriate behavior compared with the more consistently high baseline period. Although both behavior and academic performance were affected positively, the pre-to-post intervention data trend varied from subject to subject.

Discussion

The results of the present study demonstrate the effectiveness of home-based reinforcement interventions in improving the academic performance of underachieving children while simultaneously reducing associated inappropriate behavior. Academic performance covaried with the levels of corresponding inappropriate behavior of target students. This was true during both base-line and home-based treatment intervention phases.

The simplicity of the intervention plan used in the present study is perhaps of greatest importance. Behavioral interventions are often criticized for being excessively complicated and awkward to administer effectively. The

home-based intervention used in the present study required virtually no alterations in the "normal" teaching and classroom activities. Furthermore, parents, in effect, were asked to respond systematically to specific assignments. Parent training for such involvement was simple, straightforward and well-received. It is likely that behavioral interventions that are uncluttered and readily understood by all parties, such as the one used in the present study, will be implemented more systematically. If so, such interventions may prove more effective than highly detailed interventions, and certainly more popular with implementers.

The focus on academic performance represented a marked departure from previous investigations involving home-based reinforcement. During previous research, experimenters have manipulated either disruptive behavior or some combination of disruptive and academic behaviors. The authors are in agreement with Ayllon and Roberts' (1974) observation that producing students who merely refrain from inappropriate behavior is a questionable educational objective. Instead, we should avoid attempts to "make them sit still so they will learn, but rather to teach them better and they may sit still" (p. 75). While interventions that focus primarily on reduction of inappropriate behavior are likely to continue, the present study demonstrates the ease and effectiveness with which academic performance can be systematically embedded into behavioral interventions. The simplicity, yet effectiveness, of the multi-dimensional (i.e., more than one behavior) behavioral intervention used in the present study suggests that unidimensional behavioral interventions may be unnecessarily inefficient due to their limited scope. The present study illustrated the application of a form of "passive" behavioral intervention, which operates under the premise that behavior and academic performance

are highly related, i.e., changes on one dimension are likely to be characterized by corresponding changes on the other dimension. In many cases, academic interventions are likely to affect both academic performance as well as the behavior of target subjects by systematically reducing the time allotted for negative behavior or as a result of a generalized pro-social attitude resulting from positively reinforced academic performance. The possibility of developing a "passive" behavioral intervention as an off-shoot of an academic intervention presents unique and creative intervention options.

Although a strong relationship generally existed between behavior and academics, one student's level of inappropriate behavior gradually increased after the intervention had been instituted for a brief period. This student was the most disruptive during baseline and perhaps the intervention was not sufficiently potent to produce the same amount of change in behavior as in academic performance. An alternative explanation for this subject's behavior is that at first home-based reinforcement "signalled" the setting of appropriate standards for behavior to the student (cf. Witt & Adams,1980). When reinforcement was contingent upon only academic performance, the child was able to discriminate the contingency, and corresponding increases in non-contingent behavior resulted. This discrimination of the contingencies may have been easier in the present case than in the classroom-based program developed by Ayllon and Roberts where no behavioral deterioration was reported. In the classroom, the teacher can observe and deliver reinforcement for a wide range of behaviors (Marholin & Steinman, 1977). With the home-based system, on the other hand, it is probably easier for students to recognize that parents will have little or no knowledge of their classroom behavior.

Of further interest was the application of interrupted time-series analysis (ITSA) procedures to the data obtained during the present study. While the necessity of fomal statistical analyses of such data has been questioned (Michael, 1974; Baer, 1977; Parsonson & Baer, 1978), the concurrent use of ITSA and visual inspection procedures can strengthen the degree of certainty with which conclusions can be drawn--especially in cases where baseline and/or treatment patterns have not fully stabilized (Hartmann, et al., 1980). Gottman and Glass (1978) have defended the need for ITSA procedures for non-laboratory studies by stating that, unlike highly controlled laboratory studies, "one has every reason to expect small effects outside the laboratory" (p. 199). They presented interesting data regarding the lack of reliability across experimenters of the singular use of visual inspection procedures in interpreting non-laboratory data, which further support the decision-making value of supplementing visual inspection procedures with formal statistical analysis. Since school psychologists often are confronted with the task of evaluating the effects of behavioral interventions, and since the outcomes of such non-laboratory interventions are likely to be more variable than expected under laboratory conditions, the application of ITSA procedures appear to be a useful and practical approach.

An interesting component of the present study, though possibly perceived by some as a limitation, was the manner in which on-going parent involvement was accomplished. Parent participation in behavioral interventions has been found effective across a variety of target behaviors (e.g., Broden, Beasley, & Hall, 1978; Witt & Bartlett, in press). During the present study, parents received initial training in the implementation of home-based reinforcement and a book which included procedures parallel to those used in the present

study. In addition, weekly follow-up contacts were made. However, apart from the initial training and weekly contact with the experimenters, parent implementation of daily reinforcement was not monitored; instead, such implementation was inferred by the fairly abrupt changes in the behavioral and academic performance of their children. It is possible, though not likely, that behavior changes occurred purely as a by-product of the secondary reinforcement gained from improved academic behavior and without systematic reinforcement of target behaviors. Research designed to assess the effects of the frequency and consistency of parent supplied reinforcement on targeted behavior would be useful in establishing the effects of such home-based reinforcement. In addition, more research will be necessary to evaluate each of the components of the home-based system for which the parents were responsible (i.e., reading the book, going over assignments, praise, privileges) in order to determine if all are necessary.

The use of the actual assignment as the "note home" was a unique feature of the present experiment and differs from previous studies which have relied on notes summarizing school behavior. The use of the actual assignment has the advantages of providing parents more detailed information as well as a means to provide instruction at home.

Certain cautions should be exercised in interpreting the outcomes of this study. Target students each possessed average or above average ability to perform on-grade academic work. In addition, though each was disruptive in the classroom, the levels of disruption did not approximate the severity associated with emotionally handicapped students. It is not known to what extent the present intervention would affect the academic performance of low-ability students or the behavioral and academic performance of seriously behaviorally abnormal students. In addition, the home-based intervention

employed in the present study required the cooperation and participation of parents. In cases where parent support is not forthcoming, home-based interventions are not likely to succeed.

In conclusion, the major advantage of the present intervention seems to be the ease with which it can be implemented. The ease of implementation is an important variable to consider when designing new strategies. Winnett and Winkler's (1972) article entitled, "Current behavior modification in the classroom: Be still, be quiet, be docile," stimulated much self-examination among researchers in behavior modification. Their indictment of the then current status had the effect of changing markedly the types of behaviors which were subsequently chosen for modification. With tongue in cheek, we wish to propose that the present state of research in the classroom is, "be expensive, be unrealistic, and be federally funded." We must begin to examine not only the types of behaviors targeted for intervention but also the methods of intervention. A large, expensive intervention which requires several people and large quantities of time may yield desired results, but the very low probabilty that such an intervention would be used in a classroom on a continuing basis makes its practical utility questionable.

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Figure Caption

Figure 1. Percent of correct responses (triangular data points) and percent of inappropriate behavior (circular data points) for each day of experiment across students.

Table 1

Pearson Correlations Between Percent of Inappropriate Behavior and Percent of Correct Responses

	Study Phase	
Subject	Baseline	Home-Based Intervention
S_1	-.65 (8)	-.50 (20)
S_2	-.69 (13)	-.62 (14)
S_3	-.60 (17)	-.48 (9)
Overall	-.72 (38)	-.33 (43)

Note. Number of paired observations in parentheses.

[a]Negative correlations for the Baseline phase were characterized by lower percent correct responses and higher percent of inappropraiate behaviors.

[b]Negative correlations for the Home-Based Intervention were characterized by higher percent correct responses and lower percent of inappropriate behaviors.

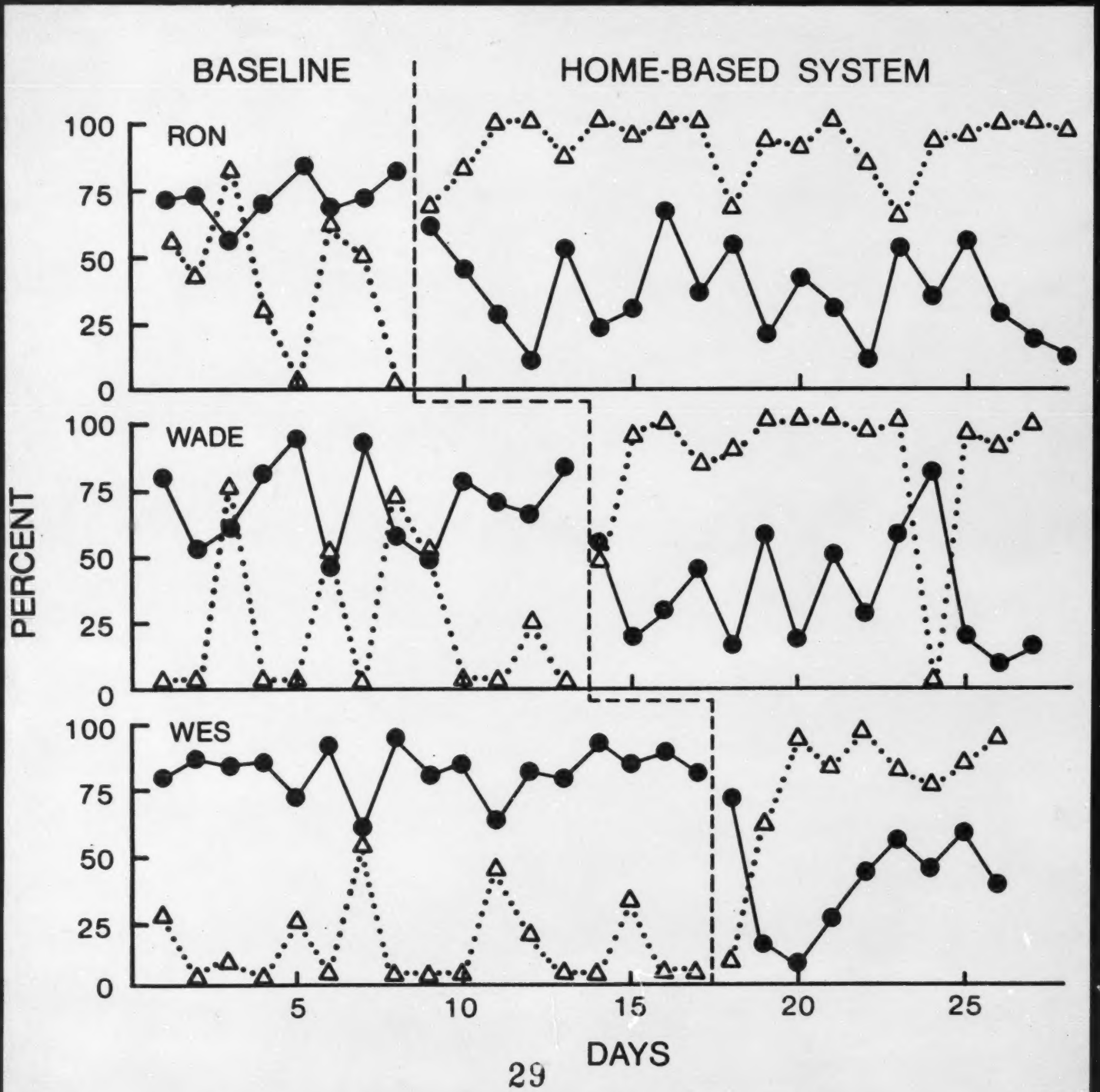
Table 2

Results of Time-Series Analysis

Source	Target	No. Observations		Change in Level			Change in Slope		
		Baseline	Treatment	"t"	df	p	"t"	df	p
				GROUP EFFECT					
Overall Intervention Effect	ACADEMIC	8	9	3.66	13	.005	2.72	13	.01
	BEHAVIOR	8	9	-3.63	13	.005	-1.32	13	ns
				EFFECT-BY-SUBJECT					
Subject 1	ACADEMIC	8	20	4.67	24	.0001	2.02	24	.05
	BEHAVIOR	8	20	-2.46	24	.05	- .71	24	ns
Subject 2	ACADEMIC	13	14	4.56	23	.001	1.04	23	ns
	BEHAVIOR	13	14	-1.92	23	.05	- .47	23	ns
Subject 3	ACADEMIC	17	9	4.40	22	.0001	.75	22	ns
	BEHAVIOR	17	9	-7.59	22	.0001	3.30	22	.001

Note. Multiple analyses conducted using an extended version of the ITSA procedures developed by Bower, Padia, and Glass (1974). For a complete description of ITSA, the reader is referred to Glass, Willson, and Gottman's (1975) Design and Analysis of Time-Series Experiments.

[a]ARIMA (p,d,q) model = (0,0,1); the remaining effects tested with ARIMA (0,0,0) model due to limited baseline observations and non-systematic influence of error variance.


BASELINE
HOME-BASED SYSTEM
RON
WADE
WES
100
75
50
25
0
PERCENT
5
10
15
20
25
DAYS